Development of a Predictive Model to Estimate the Effect of Soil Solarization on Survival of Soilborne Inoculum of *Phytophthora ramorum* and *Phytophthora pini*[1]

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Abstract

Soil solarization has been shown to be an effective tool to manage *Phytophthora* spp. within surface soils, but estimating the minimum time required to complete local eradication under variable weather conditions remains unknown. A mathematical model could help predict the effectiveness of solarization at different sites and soil depths. Prior research on solarization efficacy has focused on the minimum temperature and exposure time required to kill pathogens, and most mathematical models of the effects are based on cumulative temperature over time. However, two additional factors, soil water potential and diurnal temperature fluctuation, may influence pathogen survival. Our objectives were 1) to develop an accurate model to estimate conditions lethal to *Phytophthora* spp. based on results from controlled lab experiments and 2) to test the model with field collected data.

We assessed temperature, water potential, and intermittent heat effects on survival of *Phytophthora ramorum* and *P. pini* in infested leaf inoculum. Survival was assessed by plating the leaf inoculum and observing outgrowth of the pathogen. For both pathogens, survival frequency at higher temperatures was greater at lower water potentials. Survival was also greater when exposure to high temperature was interrupted by a cooler temperature. Results indicate that heat effects on pathogen survival increase gradually during heat treatment, suggesting the temperature effect is not simply cumulative. The mathematical model was tested in solarization field trials conducted at the National Ornamentals Research Site at Dominican University of California (*P. ramorum* and *P. pini*) and the Botany Farm, Corvallis, OR (*P. pini*) by comparing calculated heat units with and without solarization to the recovery of *P. ramorum* and *P. pini* from inoculum buried at 0, 5, and 15 cm. The model was improved significantly with the addition of water potential and temperature fluctuation as explanatory variables, allowing for greater accuracy in predicting soil solarization efficacy.

Using field weather station and soil temperature data, we then expanded the mathematical model to predict soil temperature regimes during soil solarization from inputs of solar radiation, air temperature, relative humidity, and average soil temperature in non-solarized sites. The model is currently being improved to estimate the efficacy of soil solarization in various locations in WA, OR, and CA.

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